Assimilation of Aura ozone data

I. Stajner, H. Hayashi, K. Wargan,
L.-P. Chang, and S. Pawson

Global Modeling and Assimilation Office (GMAO)
NASA/Goddard

AGU Fall meeting December 2004

Ozone assimilation at GMAO

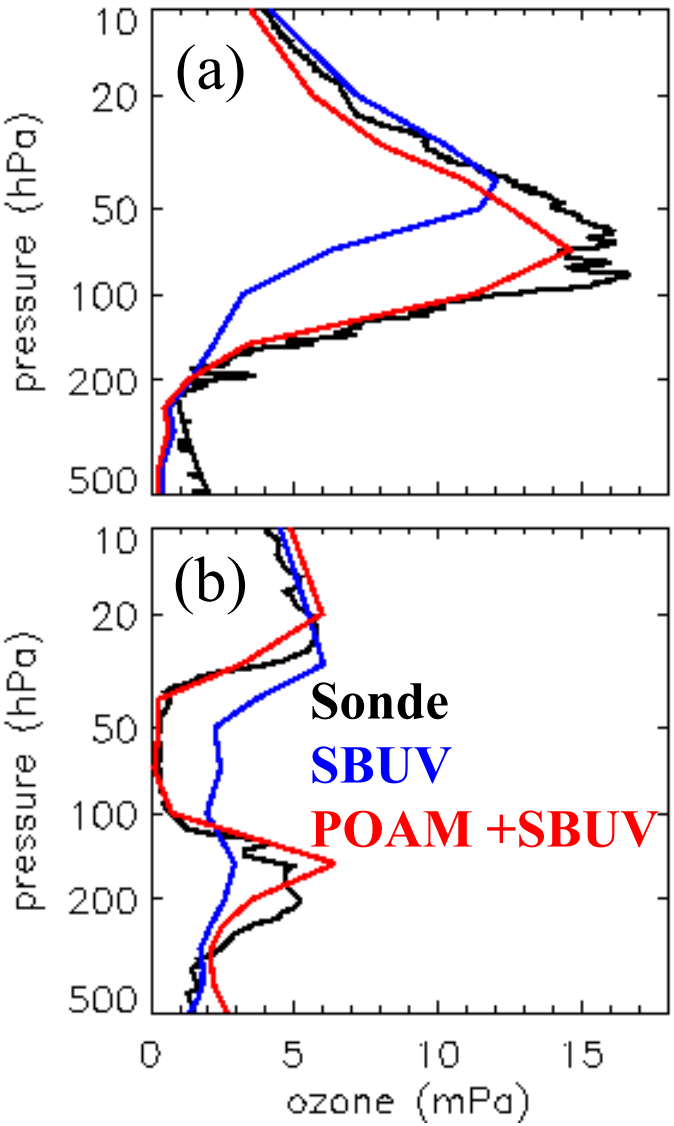
- Total ozone columns and stratospheric profiles from **SBUV/2** instrument are assimilated in near-real time into a parameterized chemistry and transport model (**CTM**) driven by GMAO assimilated winds (*Stajner et al, JGR 2004,* doi:10.1029/2003JD004118).

- This system was modified for assimilation of **OMI** total ozone columns and **MLS** profiles.

Previous work

- Previous work showed that assimilation of data from occultation and limb sounder instruments greatly improves the representation of lower stratospheric ozone:
  - **POAM III** over Antarctica (*Stajner and Wargan GRL 2004,* doi:10.1029/2004GL020846)
  - **MIPAS** globally (*Wargan et al. submitted to QJRMS*)
- These instruments provide high quality data in regions where SBUV/2 data are of lower quality or missing

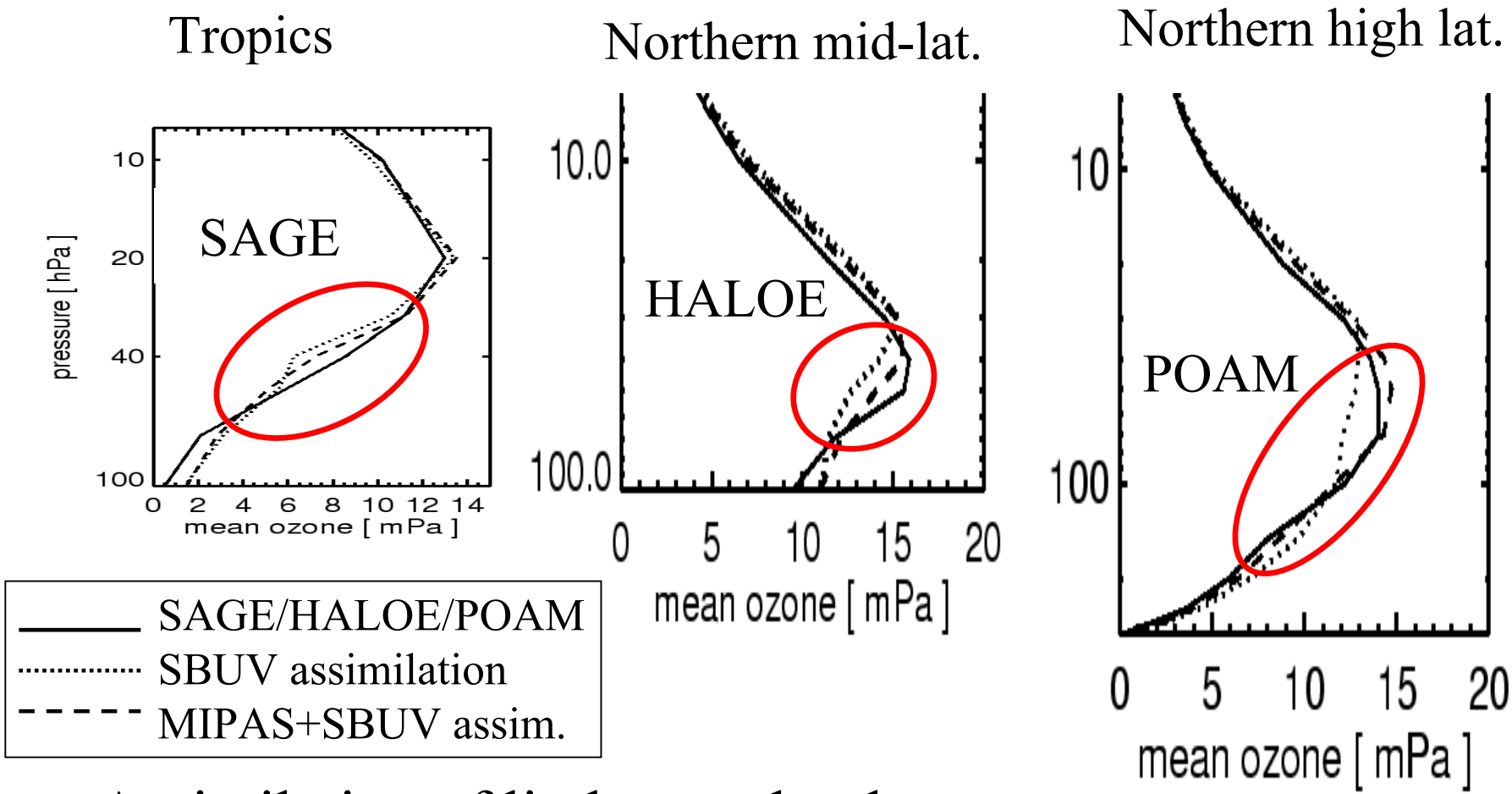
POAM III assimilation



POAM III assimilation (red) improves representation of:

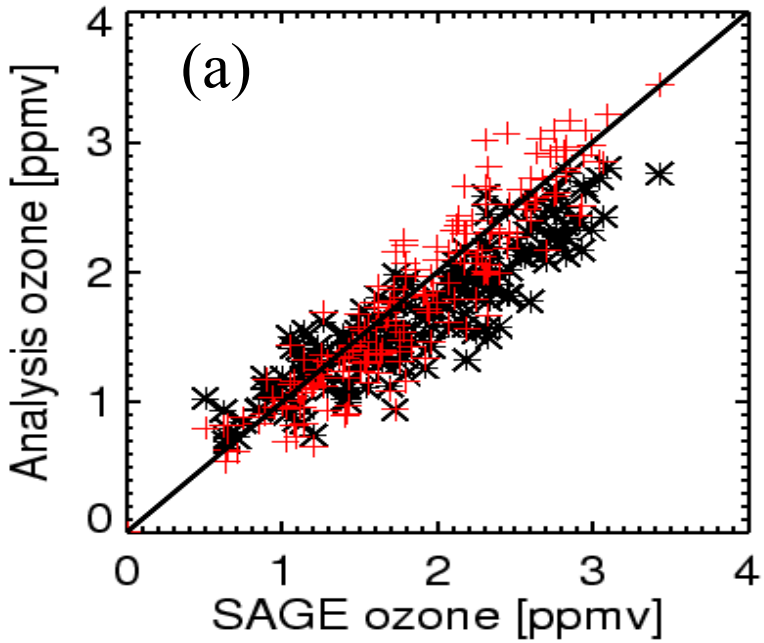
- (a) Wintertime accumulation of ozone in the lower stratosphere at Neumayer
- (b) Springtime depletion of ozone over the South Pole

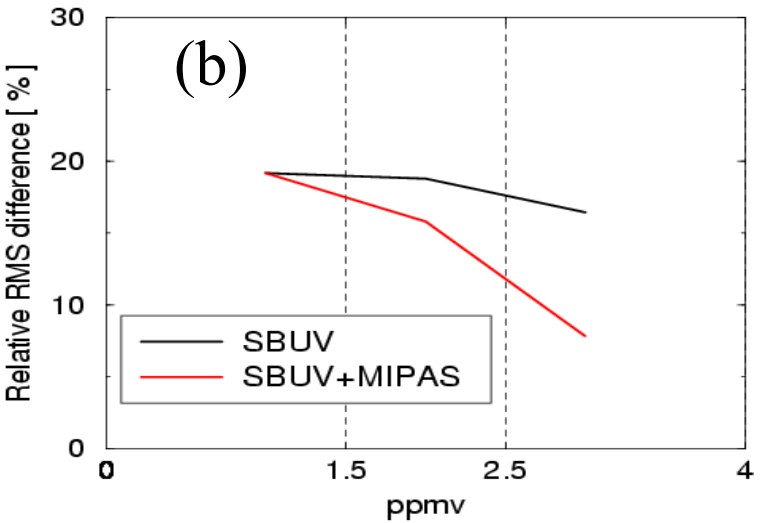
MIPAS assimilation: mean profile



- Assimilation of limb sounder data provides lower stratospheric profile shape that is in better agreement with independent occultation data

MIPAS assimilation: variability





Assimilation of MIPAS (red):

- Increases variability of ozone in northern middle latitudes at 70 hPa (a).
- Improves agreement with SAGE qualitatively (a) and decreases RMS differences between SAGE and assimilation for high and medium ozone values (b).

Aura data

Aura ozone data were assimilated:

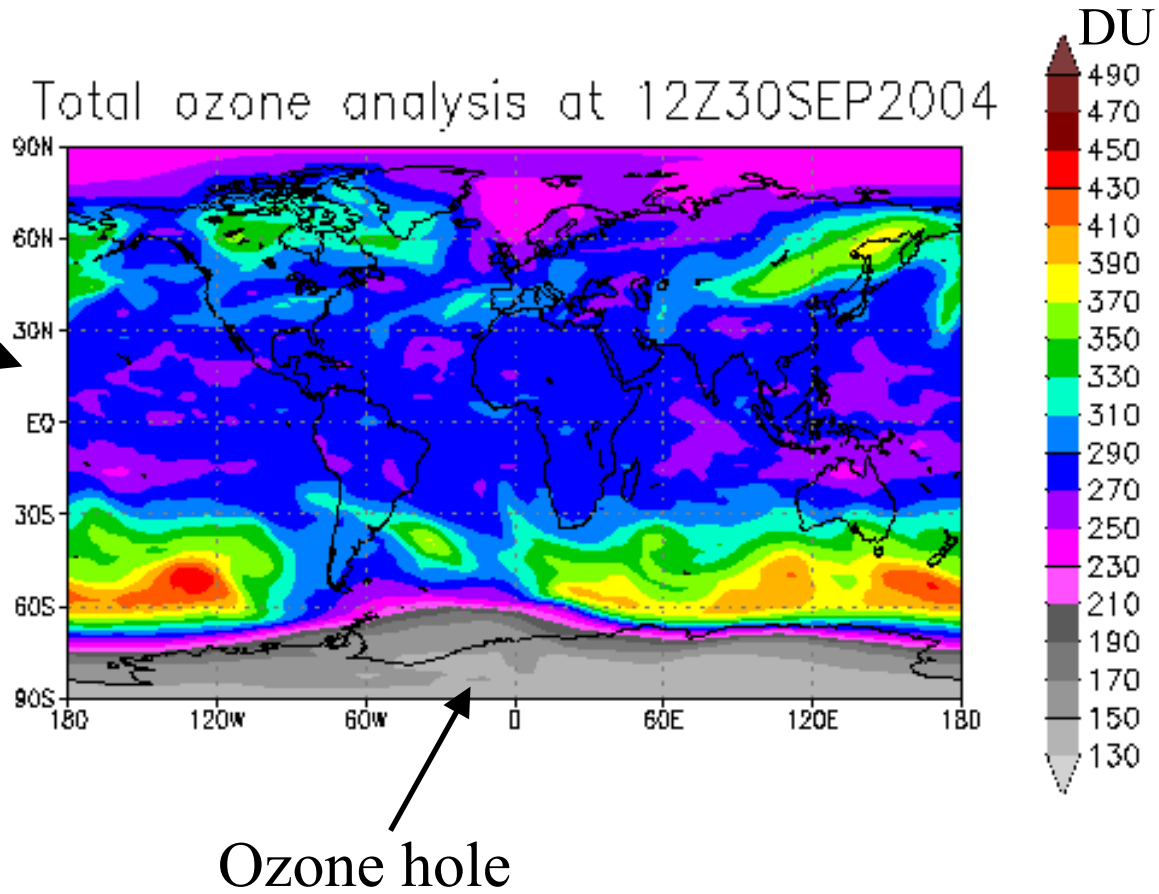
- Total column ozone data from **OMI** (OMTO3T) for September 20-30 and
- Stratospheric ozone profiles from **MLS** for pressure between 0.17 and 56 hPa (averaged values at midlevels) for September 24-29

- Preliminary evaluation includes comparisons with assimilation of SBUV/2 data and with independent ozone sonde data.

Total ozone column

Relatively smooth ozone in the Tropics

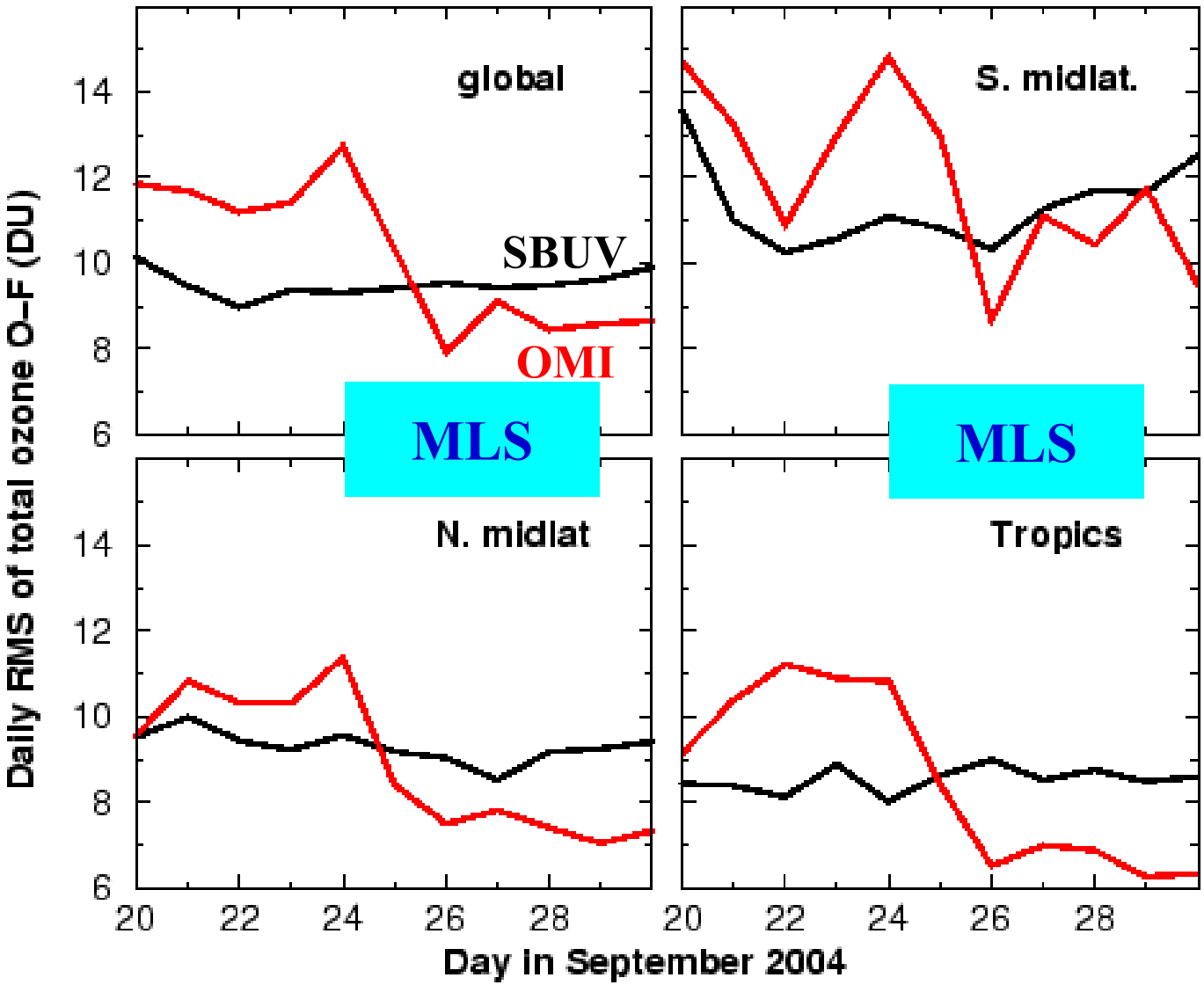
Sharp ozone gradients in southern midlatitudes



Ozone hole

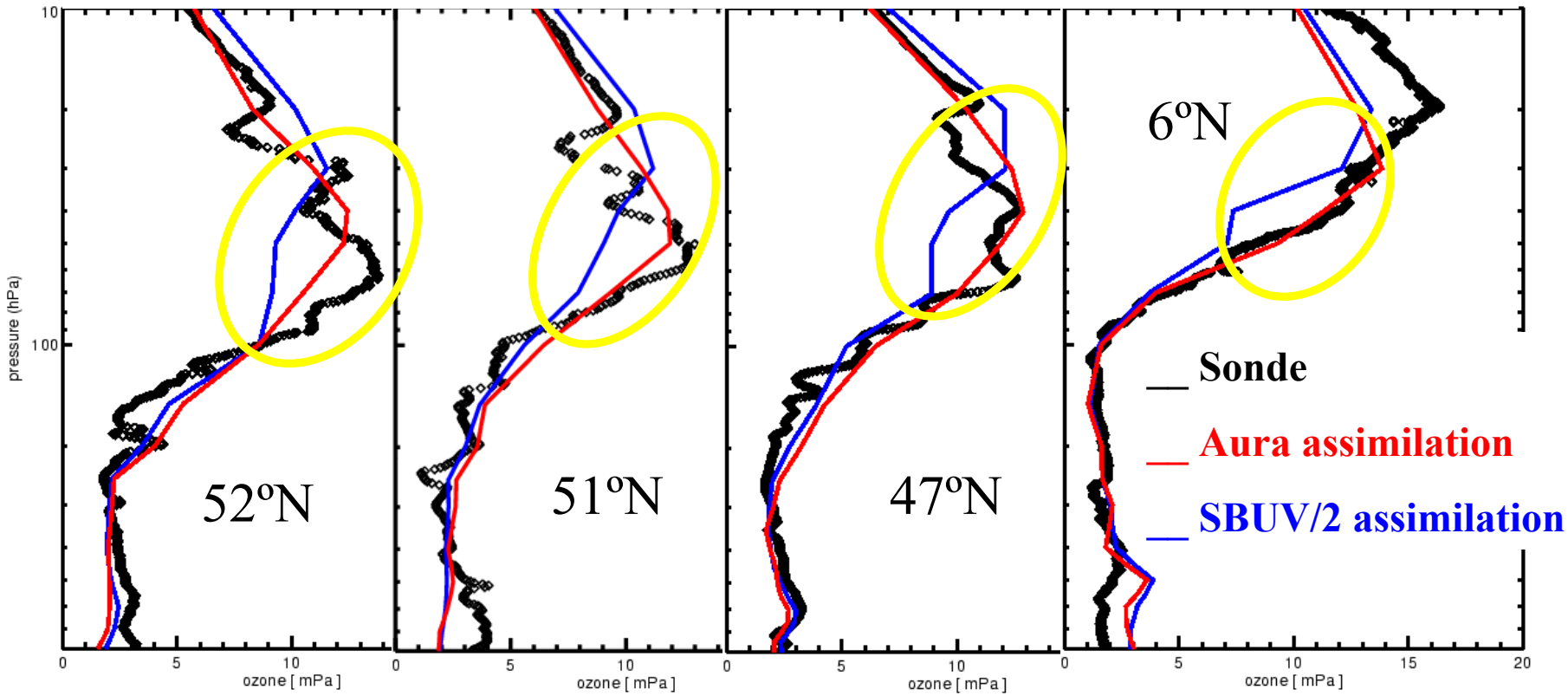
- Qualitatively correct features are seen in assimilated total ozone

Total column O-F residuals: Aura vs SBUV/2 assimilation



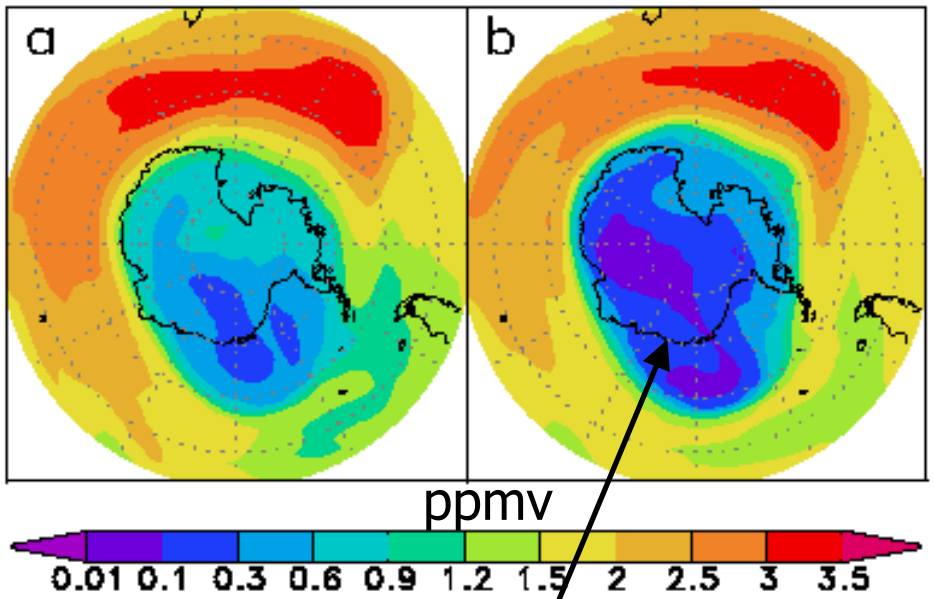
- Total ozone O-F residuals for **OMI** drop after MLS assimilation started on September 24.
- **OMI** O-F residuals are smaller than those for **SBUV/2** (black) for Sept. 26-30

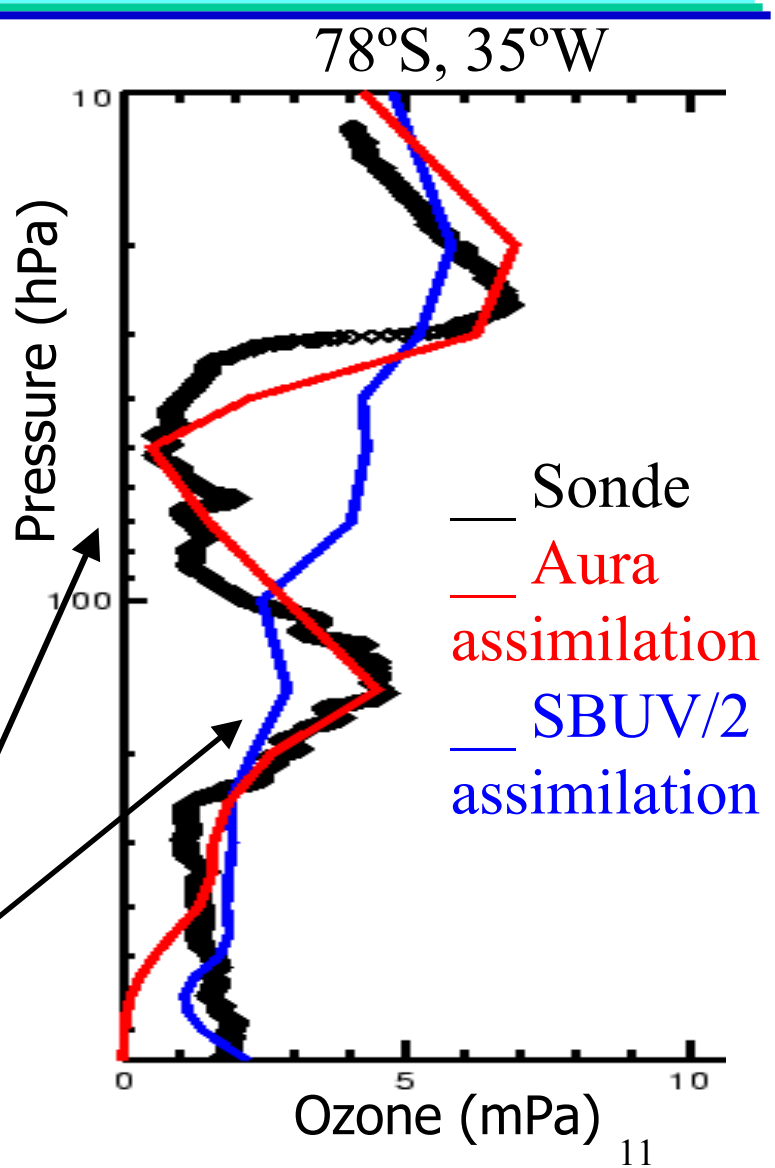
Comparisons with sondes on September 29, 2004



- **Aura assimilation** is in better agreement with **sondes** than **SBUV/2 assimilation**, especially for profile shape in the lower and middle stratosphere

Ozone hole

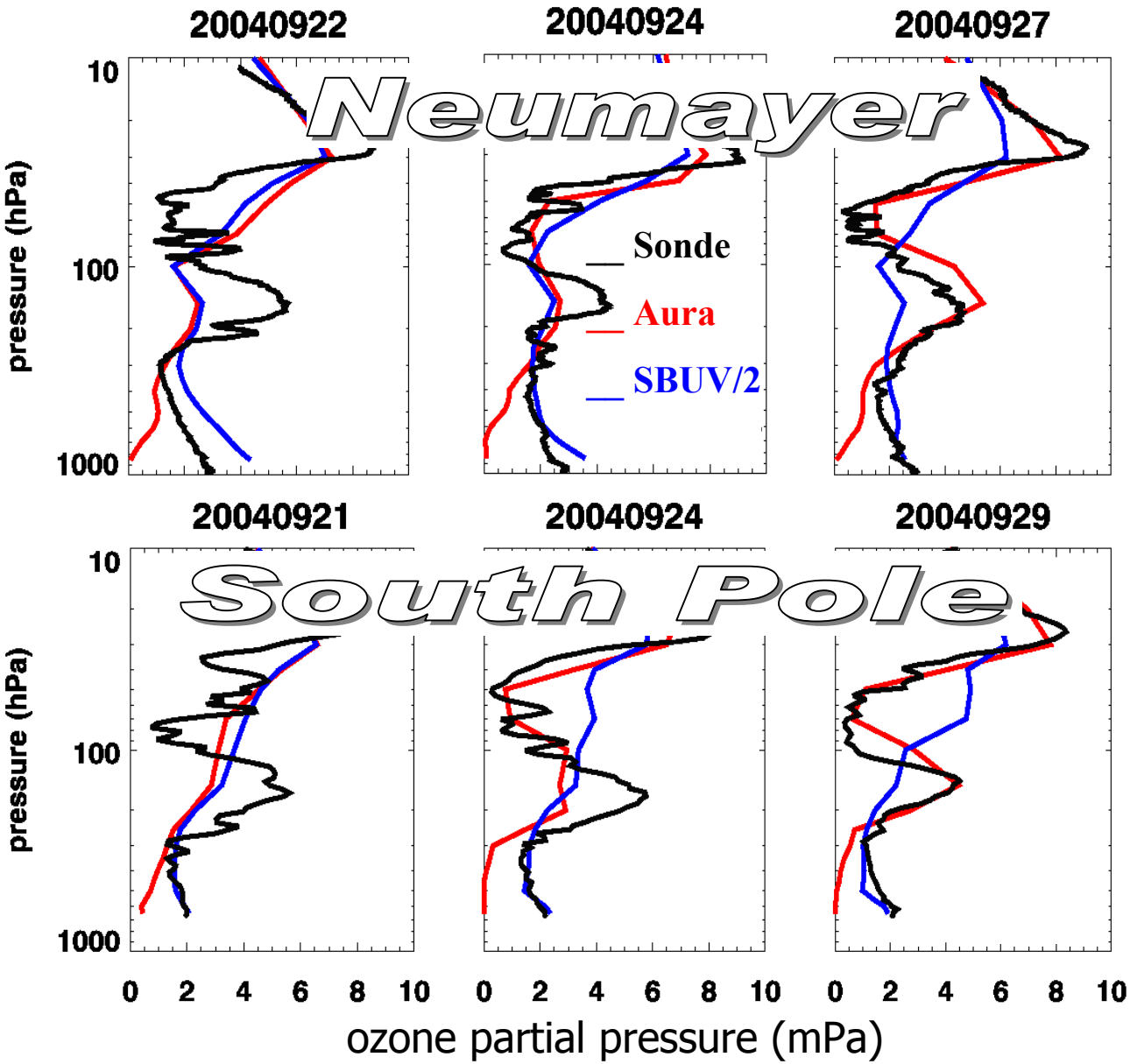




Aura assimilation:

- Gives a deeper ozone hole at 70 hPa than SBUV/2 assimilation
- Agrees better with the ozone sonde at Belgrano than **SBUV/2 assimilation**

Evolution over Antarctica



- OMI assimilation reduces ozone in the troposphere (Sept. 20-24)
- MLS data starting on September 24 correct the profile: reduce ozone near 70 hPa and increase ozone near 200 hPa
- Need to investigate behavior in longer runs. Also, avoid assimilating total column data alone. Use averaging kernels.

Conclusions

Aura ozone data were assimilated:

- Preliminary evaluation shows qualitatively better total ozone fields with a better defined “ozone hole” and gradients in the lower stratosphere than in the SBUV/2 assimilation
- OMI total ozone column O-F residuals decrease when MLS data are introduced – shows that data are consistent
- Aura assimilation compares better with independent ozone sondes than the SBUV/2 assimilation, as expected
- Further evaluations and scientific applications will follow …